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DEPARTMENT OF THE ARMY
Fort Detrick
Frederick, Maryland

[Following is translation of a German Language article by K. Marcuse, B. Menze and H. D. Pohle in Zentralblatt für Bakteriologie (Central Journal for Bacteriology) Vol. 169.]

INCIDENCE OF SALMONELLA IN WEST BERLIN

Third Communication
Proposed Classification of Varieties by "Risk"

Infections by Sal. enteriditis in Berlin were grouped for the years 1950-1957 and discussed in the two previous communications (Central Journal of Bacteriology, Vol. 169 and 180) primarily on the basis of epidemiological, sociological and statistical characteristics.

Whereas the findings of Pohle were based on the evaluation of the period from 1950 to 1954, we were able to augment these by the corresponding data for the subsequent period. By reason of more widely developed and basic data, a number of additional points of discussion uniform in themselves resulted which go beyond the purport of the previous communications and form the specific theme of this third communication.

Conditions in West Berlin appeared to make it pertinent to treat the influence of an internal German migration separately so that special attention is given to this complex. The present investigations no longer take this group into consideration since univalent possibilities of comparison are lacking for our problematics here.

In order to render the basic data as up-to-date as possible and quantitatively more probant, we have processed the findings on salmonella of the succeeding years 1958 and 1959 on the basis of the already familiar viewpoints and were thus able to extend coverage further. This then results in a total reporting period for the years from 1955 to 1959 in which we can report, without taking into consideration immigrants, more than 2,996 new cultures of sal. enteriditis in the Five Official Medical Testing Laboratories of Land Berlin (we are indebted to the Chiefs of the Official Medical Testing Laboratories for furnishing us with the basic data).

Proceeding on the assumption that the individual varieties of the Sal. enteriditis group cannot be evaluated uniformly from the viewpoints of nosology and epidemiology, we have made the attempt to establish a scale of "degree of risk". The attempt resulted from the widely held opinion that there are "less harmful" types among Sal. enteriditis in regard to infectiosity.

In order to find a degree scale for estimating "risk", we establish the following classification based on the total of individual objectively verifiable characteristics:

1. Distribution - numerical incidence;
2. Pathogenicity - ratio of sick (presumably bed patients) to non-sick infected individuals;
3. Infectiosity - number of group and/or chain infections;
4. Persistence - duration of positive test reaction.

These four points are based on figures which are <u>real</u>. They involve in addition, however, such imponderables as housing conditions, nutritional habits and personal hygiene which cannot be objectively integrated as components of <u>exposure</u> as well as the entire complex of processing an individual case on the basis conditioned by its disposition.

In the sequence of characteristics distribution occupies first place because it is the causal prerequisite for the other points of evaluation. As shown in table 1, distribution furnishes information of the annual situation by number and variety of type and is applicable to Land Berlin with about 2.1 million inhabitants.

In order to afford the reader possibility for comparison, the years from 1951 to 1954 from the first communication were included. However, the progression of types is arranged by the ratio of incidents in the years 1955 to 1959 as indicated in the last column (total).

Annual distribution shows that Sal. breslau -- as anticipated -- leads in regard to incidence with about 29% of the total, or almost one-third. The proportional grouping of the other types and their frequency per year shows a more fluctuating picture (in contrast to breslau which has a relatively uniform trend) as far as the figures by order of magnitude still permit comparison. In almost every type, we observe obvious peaks, e.g. Sal. newington, St. Paul, Braenderup, Thompson and others. Types of lesser total number such as Sal. montevio and manchester show peaks which are, however, not supported by any recognizable group infections. As far as can be seen, this concerns primarily infividual manifestations, i.e. so-called scattered cases.

Table 1. Annual Distribution of Salmonella Enteriditis

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1955-59
B. breslau	57	123	195	153	253	212	90	133	224	198	857
E. anatum	—	3	20	255	201	47	42	29	27	62	207
E. newington	—	—	—	25	57	7	28	6	139	11	191
C. infantis	—	—	—	9	42	28	52	42	16	20	158
C. braenderup	—	—	—	—	—	96	32	11	7	6	152
B. st. paul	—	—	—	—	6	2	1	10	111	14	138
C. thompson	—	4	9	17	27	20	81	17	2	2	122
C. give	1	13	47	48	51	21	23	6	23	7	80
C. blockley	—	—	—	—	—	5	—	41	35	25	106
D. gaertner	24	37	34	50	23	23	7	6	42	13	91
C. bareilly	—	—	—	91	12	2	6	28	3	—	69
B. heidelberg	—	—	—	5	26	3	2	20	28	15	68
C. newport	8	2	69	175	17	13	5	35	10	—	63
B. schwarzengrund	—	—	—	—	22	7	22	8	19	5	61
B. derby	28	15	7	43	9	5	15	12	15	12	59
C. montevideo	—	1	3	2	2	6	7	25	5	8	51
C. manchester	—	—	—	1	—	—	—	—	45	4	49
C. kottbus	—	—	—	57	6	—	—	6	16	21	43
C. muenchen	—	3	13	142	9	6	18	2	4	1	31
E. senftenberg	—	1	5	6	8	8	3	9	8	1	29
C. kentucky	—	—	—	—	7	9	10	8	—	1	28
C. mission	—	—	—	—	—	—	—	—	—	26	26
D. dublin	—	1	6	23	15	7	6	3	2	5	23
E. meleagridis	—	—	—	7	9	7	2	4	7	3	23
E. binza	—	—	—	—	1	—	1	6	15	—	22
E. orion	—	—	—	—	10	3	2	6	3	—	14
E. new brunswick	—	—	—	—	—	2	1	7	2	3	15
C. oranienburg	1	5	4	3	2	8	1	9	2	—	20
C. cholera suis	3	6	—	—	1	1	13	1	1	3	19
B. bredeney	—	—	1	4	14	3	10	—	2	3	18
B. chester	—	—	—	—	12	2	6	1	4	3	16
C. manhattan	—	—	—	1	1	1	5	8	1	—	15
B. san diego	—	—	—	—	—	—	1	3	5	1	10
B. reading	—	—	—	—	1	2	1	—	—	7	10
C. potsdam	—	10	2	1	1	4	2	—	[illegible]	1	7
C. bovis morbificans	—	—	—	4	3	3	1	1	2	—	7
E. muenster	—	—	—	—	—	—	1	1	3	2	7
B. brandenburg	2	4	4	1	1	—	1	—	4	1	6
C. livingston	—	—	—	—	—	—	—	—	—	5	5
D. texas	—	—	—	—	—	—	1	1			5
E. amager	—	—	—	—	2	—	5	—	—	—	5
D. panama	2	—	1	6	1	—	—	—	3	1	4
C. edinburgh	—	—	—	—	—	—	—	3	—	—	3
C. virchow	—	—	1	—	—	2	—	—	—	1	3
E. nyborg	—	—	—	—	9	—	—	—	—	3	3

Observed twice from 1955-1959

C. onderstepport, E. asconi, C. tennessee, C. chicago, D. blegdam, B. agami

Observed only once from 1955-1959

B. cooln, B. indiana, B. islam, B. undifferenziert, C. undifferenziert, C. ituno, D. napoli, D. trintrop, E. Vejle, E. west hampton, E. goerlitz, E. tuebingen, E. new haven, E. aberdeen, E. undifferenziert, G. lille, E. schooneberg

Another form of distribution can be seen in the sudden incidence of Sal. types which were noted in previous years either not at all or only very infrequently and sometimes also in intervals (since certain reservations such as the influence of prescribing obligatory examinations of escapees (beginning in 1953) as well as differences in laboratory technique exist for the years 1950 to 1954 (Pohle), evaluation will be referenced only to the later years). An example of newly occurring types are Sal. braenderup, blockley, mission isangi, new brunswig, livingston, and others. A recurrence after neutral years is found for Sal. manchester and kottbus.

Epidemiologically, it is characteristic that Sal types occurring once in demonstrable numbers have become indigenous. The absence of new test cultures for individual bacilli for the last year (1959), especially for Sal. bareilly and newport, is not regarded as sufficient proof of their disappearance from the epidemic situation.

An occasional incidence as for Sal. amager, edinburg, etc. cannot be taken into consideration within this sense and is intended to show merely that they have not established themselves. The conjunction with the above declaration therefore also indicates that the number of types found per year -- as already observed at the time by Pohle -- has increased.

Manifestations such as occurrence of peaks and intervals, reincidence as well as occasional incidence of certain bacilli induced us, in the attempt at explanation, to search for connections to findings in the veterinary sector.

From findings for Hamburg as a foreign-trade port (results of oriented examination of suspected import goods), a dependency relation within the meaning of the former term "food-poisoning agents" had to be considered also for Berlin.

A demonstration for such a relation could not be adduced because bacteriological control examinations after passage through such "filtering procedures" as the examination of imports in seaports and transloading centers, takes place in the interior only under certain prerequisites. It results from this that, in comparison to the legally prescribed examinations in the human sector, corresponding findings would be numerically unsatisfactory.

On the basis of the four distinctive points, point 1, numerical incidence, in itself must be evaluated as an index of "risk". Each one of these cases (about 3,000, confirmed by a first finding of the respective bacillus) represents a proved potential risk for the general

public. In addition to the confirmed figures, we must also assume "undisclosed cases". The latter are constituted, among others, of infections not recognized through omission of bacteriological examination in non-characteristic diseases or through less than complete execution of the legally prescribed examinations (examination of persons in the milieu and those handling foodstuffs). Such diagnostic limits as transmigration of proteus to the cultures, over-age, and even unsuitable specimen submitted must also be taken into account here.

Point 2 of the risk scale is the most important criterion for evaluation because it indicates in general the infectious activity of the respective bacillus. Disregarding such additional factors as disposition and exposure, this is essentially the basis of the morbidity statistics which serve as specific orientation for the health authorities.

The question of classification by pathogenicity cannot be directly answered from the relation of the initial (first demonstration) test cultures to patients in Berlin. By reason of local legislation, that part of the population handling foodstuffs (about 100,000) and differing within itself from the general population is included. The findings from the repeated annual mass examinations of this part of the population are non-oriented and falsify the picture of the orisnted findings made for diagnostic reasons. It has been proved that the group of the so-called food handlers furnishes primarily carriers ("Ausscheider") but patients only in very infrequent cases, even for Sal. types which represent in other population components a high share of the sick. Even though the findings for food handlers will not be considered at this time, their influence on the general factor "risk" will nevertheless have to represent an essential part of epidemiology. Findings among food handlers were eliminated from table 2 so that a reference figure was obtained, by subtraction from the total, from which the percentage of the sick per type has been calculated as far as possible under statistical rules.

For the term of pathogenicity, we have a reference figure of 1,974 initial test cultures available which consist of 612 or 31% of cases of sickness. Since the reference figures differ greatly in their magnitude, table 2 was broken down by quantitative viewpoints rather than by biological classification so that a statistically valid proof (order number 1-3) and a percentually still comparable (with the reservation of small number) group (order number 4-10) appeared.

Table 2. Pathogenicity (Types of Salmonella with no known cases of illness -- this concerns only some individual findings -- are not listed in table 2 because the prerequisites for the present problematics is absent)

Order number	Type	Reference total	Total of sick	%
1	B. breslau	747	317	42,3
2	E. newington	127	11	8,8
3	C. infantis	96	29	30,2
4	E. anatum	89	17	19,9
5	B. st. paul	83	19	23,0
6	C. braenderup	82	32	39,2
7	C. thompson	69	16	22,6
8	C. blockley	55	14	25,2
9	D. gaertner	50	21	42,0
10	B. heidelberg	49	17	34
11	E. give	44	4	
12	C. bareilly	42	13	
13	C. newport	40	12	
14	B. schwarzengrund	35	7	
15	C. kottbus	34	3	
16	B. derby	29	7	
17	C. montevideo	26	4	
18	C. manchester	25	2	
19	D. dublin	21	4	
20	C. cholerae suis	18	7	
21	C. mission isangi	17	3	
22	C. muenchen	15	1	
23	C. oranienburg	12	1	
24	E. meleagridis	12	1	
25	E. orion	12	1	
26	E. senftenberg	11	1	
27	B. bredeney	11	6	
28	C. manhattan	10	2	
29	C. kentucky	10	2	
30	E. new brunswick	10	1	
31	B. chester	9	3	
32	E. binza	8	2	
33	B. reading	8	3	
34	C. potsdam	5	3	
35	C. livingstone	5	2	
36	D. panama	4	2	
37	B. san diego	4	1	
38	B. brandenburg	4	2	
39	C. virchow	3	1	
40	C. bovis morbificans	2	2	

Sal. breslau here also assumes a special position as it does for "distribution" and leads with 42.3% of cases far ahead of Sal. newington (8.8%) and Sal. infantis (30.2%) which are close enough to the border line of 100 to permit statistically valid conclusions.

In the second group, pathogenicity of Sal. enter. reaches with 42% that of Sal. breslau and is followed by Sal. braenderup with 39.2%, heidelberg with 34.0% and blockley with 25.2%. The remaining types are much smaller in number.

In contrast to the types listed with a high share of pathogenicity are Sal. newington and anatum where the "rate of sickness" is low with a relatively high incidence.

In the next groups -- where the figures are percentually no longer significant -- some types with a high rate of sickness of more than 25% are notable such as Sal. bareilly (No. 12), newport (No. 13), derby (No. 16), choleraesuis (No. 20) and bredeney (No. 27). We believe evaluation within the meaning of our distinctive characteristics of evaluation as justifiable also for these types because the reference figures still lie outside of purely random quotas so that the pathogenicity of the respective types deserves attention.

Infectiosity of Sal. enter. as third point on the risk scale was measured by the number of group infections.

Infection of serval persons by the same bacillus comprises two epidemiologically different processes which are the simultaneous common infection of a group of persons and consecutive contact infection from person to person. This clear division could not be effected for the present problematics because the most important factor in the recognition of a true chain -- the intervals between positive initial test cultures within the group -- could not be determined sufficiently reliably in spite of uniform laboratory techniques. External circumstances play a role here which influence the time factor of the results of examination and include primarily irregularities in the dates of sample submission. There must be added to these generally organizationally conditioned sources of error such imponderable components, in the individuals examined, as disposition, amount of bacilli and/or toxins absorbed, etc. It will therefore be understandable that we forewent a definite decision on transmitting and on infected patients and merely used the general term of "group infection".

In addition to patient's histories and questioning of carriers in the food trades, the greater number of initial positive reactions were investigated in each case, in order to determine whether a group

character might be assumed on the basis of at least three concordant factors (sameness of type, family name or residence). By keeping within the strict postulates, a number of infections have certainly escaped inclusion as group (e.g. change of residence, change of name through marriage, etc.) so that the findings are based only on minimum numbers.

However, it seems reasonable to assume that the sum of group infections contains a considerable number of true chains. Whether due to direct or to contact infection within the groups does not seem, however, of primary importance in evaluating the degree of risk of the individual varieties but is decided rather by the overall picture of their participation.

In the years 1955 to 1959, 224 group infections with a total of 700 (or 22.3%) individual cases were observed among a total number of 2,996 initial test cultures of Sal. enteriditis. Of the total of 68 types determined, 30 participated in group infections.

Table 3

Order number	Type of Salmonella	A No. of groups	A total test cultures	Index	Individuals involved	B Number of individuals in group 2	3	4	5	and over	
1	breslau	98	857	11.4	285	62	23	5	4	4	(23,13,9,7)*
2	st. paul	12	138	8.9	28	9	2	1	–	–	
3	infantis	11	158	6.3	25	7	3	–	–	1	(6)
4	braenderup	10	152	6.5	27	6	2	1	1	–	
5	anatum	9	207	4.3	20	8	–	1	–	–	
6	newington	8	191	4.2	69	7	–	–	–	1	(55)
7	gaertner	8	91	8.8	20	4	4	–	–	–	
8	heidelberg	8	68	11.9	22	5	2	–	–	1	(6)
9	bareilly	7	69	10.1	26	2	3	–	–	2	(6,7
10	manchester	7	49	14.3	16	5	2	–	–	–	
11	give	7	80	8.7	14	7	–	–	–	–	
12	schwarzengr.	5	61	8.2	25	2	1	1	–	1	(14)
13	newport	5	63	8.0	12	3	2	–	–	–	
14	blockley	4	106	3.4	18	2	1	–	–	1	(11)
15	thompson	3	122	2.4	8	2	–	1	–	–	
16	new brunswick	2	15		7	1	–	–	1	–	
17	muenchen	2	32		5	1	1	–	–	–	
18	miss. isangi	2	36		4	1	1				
19	montevideo	2	51		4	2	–				
20	hottbus	2	43		4	2	–	–			
21	arnfriedberg	2	29		4	2	–	–	–	–	
22	bov. morb.	2	7		4	2	–	–	–	–	
23	bredeney	1	18		3	–	1	–	–	–	
24	chester	1	10		3	–	1	–	–	–	
25	kentucky	1	28		2	1	–	–	–	–	
26	s. diego	1	10		2	1	–	–	–	–	
27	reading	1	10		2	1	–	–	–	–	
28	brandenburg	1	6		2	1	–	–	–	–	
29	chikago	1	2		2	1	–	–	–	–	
30	amager	1	2		2	1	–	–	–	–	
		224			700	148	48	10	6	11	

* Number of individuals involved

Since table 3 is broken down on the basis of the absolute number of group infections, the order of progression of the 30 types mentioned above does not coincide with the overall review in table 1. For statistical reasons, merely the first 15 types can be discussed in detail. Specific interpretation must take into account two viewpoints -- as designated in table 2 by section A and by section B -- because we have to take into account both the number of individuals involved in multiple or repeat infections as also the amount of group infections in itself.

The number of individuals involved in the individual series of infections shows variations which make themselves felt (as is shown in particular by the last column of section B) through specially conditioned cumulations, e.g. schools. In regard to the evaluation characteristic "infectiosity", there here exists an interrelation with the characteristic "distribution" so that an assignment from the first viewpoint had here to be relegated to the background.

By contrast the amount of groups in itself (section A) offers, by reason of its relation to the initial test cultures, a better measure of evaluation for the recognition of "purified infiltrability" of enteritis Salmonellae. As basis of the calcualtion of index noted in the table, this relation offers the possibility to make the order of progression more objective by basing it on the mean value as zero point. As shown in the following, the thus resulting polarity indicates that the previously dominating Sal. breslau occupies only third place after Sal. manchester and heidelberg.

Of the fifteen types of the listing in table 3-a, 9 or three-fifths lie above the zero point and therefore within the range of increased infectiosity. It is shown further that the distribution (number of initial test cultures) does not need to run parallel with infectiosity because the six Salmonella types below the zero point include four which are more highly distributed.

The question of infectiosity includes an additional fifteen types of Salmonella (starting with order number 16 of table 3) which, at small total number, show group infections but could not be arranged under polarity.

Of all the 68 Salmonella types demonstrated in Berlin, group infections were not observed for 38 among them, including Sal. derby with the relatively high number of 59 individual findings.

Table 3-a. Polarity Profile

Order number shown in Table 3	Type	Index	
10	S. manchester	14,3	Increased infectiosity
8	S. heidelberg	11,9	
1	S. breslau	11,4	
9	S. barcilly	11,1	
2	S. st. paul	8,9	
7	S. gaertner	8,8	
11	S. give	8,7	
12	S. schwarzengrund	8,2	
13	S. newport	8,-	
			Zero point (7,8)
4	S. braenderup	6,5	Decreased infectiosity
3	S. infantis	6,3	
5	S. anatum	4,3	
6	S. newington	4,2	
14	S. blockley	3,4	
15	S. thompson	2,4	

The extent of the groups is generally small (section B of table 3). Main emphasis is in the groups of two and three cases in which the infection of only two individuals alone constitutes two-thirds of the total number of these multiple infections. Among the remaining third, the sum of infections of more than five persons deserves special mention because its share with about 5% of the group infections appears to be relatively large.

In connection with the discussion of infectiosity, it is possible to illustrate the influence of milieu as one of the imponderable factors mentioned earlier. According to the reports on 224 group infections, 114 of these took place in families which is a range easier to restrict epidemiologically. Less favorable, in regard to scattered propagation, are the 29 group infections in the hospital or home milieu and the 62 multiple infections which involved individuals from the food trades.

The further question of how many group infections were due to infection and resulting sickness through carriers or vice versa could not be clarified for reasons already discussed (time factor of examination procedure and incubation).

As the fourth and last criterion for the degree of rick of the enteritis bacilli, persistence in the organism was to be examined as

measured on duration of positive test reaction. This investigation afforded indications how often and for which bacilli only a single (temporary) or short-interval emission occurred or whether a long-interval emission characterized the bacillus as constituting a greater risk. We must evidently conclude that the danger of scattered propagation increases parallel with long-interval emission. The results should be regarded as those of an investigation based only on the findings of two of the official Medical Test Laboratories (laboratory logs and institute card files furnished the basic data for initial test cultures and chronological sequence of follow-up examinations).

Representing 51 serological types, a total of 927 strains of Sal. enter. were investigated in regard to duration of persistence and the duration of emission can be found in detail in table 4. The table cannot be considered in conjunction with the general review in table 1.

Official regulations prescribe three follow-up tests for any new positive case. The intervals of submission of the control tests are subject to variations due to external circumstances so that we have combined the true temporary "carriers" (positive only once) with the short-interval "carriers" (two to five days). In regard to the evaluation of risk, the latter differ only little from temporary carriers. In the subsequent columns II-V, the variations in time intervals largely compensate each other.

Column I represents in our experience the larger share of the total number of carriers and amounts to approximately 62%. This category also contains the 12 types which remained constantly negative after temporary or short-interval emission. More than a third of the total cases show a long and/or very prolonged (more than two months) duration of emission. The percentual distributions in the breakdown of columns I-V are listed in the table both for Sal. breslau as well as for the total figures and show a certain regularity. Sal. breslau which has already been discussed separately in regard to the other evaluation characteristics, esentially follows this breakdown and even appears to lie below the total percentage in regard to the longest duration of emission (more than 60 days). By contrast, such types as Sal. thompson and give with their "long-interval carriers" predominate in relation to the absolute number of findings. (Note: In connection with this, we might mention as an exception a duration of emission of several years for Sal. give (2 x for over 4 years), for Sal. enter. (1 x for over 7 years) and for Sal. panama (1 x over 8 years)). For median duration of emission of 2 to 8 weeks, Sal. newington, branderup and manchester are particularly notable.

Table 4. Tests for Duration of Emission. (The five types Sal. amager, taxoni virchow, tuebingen and dahlem were found temporary only once.)

Order number	Type	Total number of cases	I 1-5 days in	(%)	II 6-14	(%)	III 15-30	(%)	IV 31-60	(%)	V bis 60	(%)
1	S. breslau	222	129	(58,1)	43	(19,4)	24	(10,8)	19	(8,5)	7	(3,1)
2	S. newington	94	46		28		17		3		–	
3	S. thompson	71	44		11		7		3		6	
4	S. anatum	62	51		3		3		2		3	
5	S. braenderup	58	38		7		7		3		3	
6	S. ent. gaertner	39	29		2		2		3		3	
7	S. st. paul	39	24		7		5		1		2	
8	S. blockley	34	22		6		3		2		1	
9	S. infantis	32	24		3		2		2		1	
10	S. give	32	13		2		7		5		5	
11	S. manchester	28	15		2		7		3		1	
12	S. heidelberg	20	11		7		1		–		1	
13	S. newport	19	12		3		4		–		–	
14	S. kottbus	16	9		1		2		2		2	
15	S. montevideo	15	8		3		2		2		–	
16	S. cholera suis	13	5		5		1		–		2	
17	S. muenchen	11	8		2		–		1		–	
18	S. oranienburg	10	7		1		2		–		–	
19	S. derby	10	6		2		–		2		–	
20	S. binza	9	6		2		–		1		–	
21	S. chester	8	6		1		–		–		1	
22	S. schwarzengrund	7	5		1		–		1		–	
23	S. orion	6	4		1		1		–		–	
24	S. senftenberg	6	6		–		–		–		–	
25	S. st. diego	6	4		1		–		1		–	
26	S. bareilly	6	4		1		1		–		–	
27	S. potsdam	5	4		1		–		–		–	
28	S. dublin	4	3		–		1		–		–	
29	S. mission	4	4		–		–		–		–	
30	S. kentucky	4	3		1		–		–		–	
31	S. meleagridis	4	4		–		–		–		–	
32	S. reading	3	3		–		–		–		–	
33	S. nyborg	3	3		–		–		–		–	
34	S. bov. morb.	3	2		–		–		1		–	
35	S. manhattan	3	3		–		–		–		–	
36	S. bredeney	3	1		1		1		–		–	
37	S. muenster	2	1		–		–		1		–	
38	S. indiana	2	2		–		–		–		–	
39	S. panama	2	–		–		–		–		2	
40	S. aberdeen	1	–		–		–		1		–	
41	S. ondersteepoort	1	–		–		1		–		–	
42	S. goerlitz	1	–		–		1		–		–	
43	S. siegburg	1	–		1		–		–		–	
44	S. irumo	1	–		1		–		–		–	
45	S. new brunswick	1	–		–		–		–		1	
46	S. brandenburg	1	–		–		–		–		1	
		922	569	(61,9)	150	(16,1)	102	(11,0)	59	(6,3)	42	(4,5)

The individuality of biological behavior of Sal enter. does not permit any overall numerator in the form of any univalent graduation for the individual type. Consequently, all attempts to arrange the four evaluation characteristics in a uniform objective sequence are unsatisfactory since, disregarding numerical differences, the inherent ponderability of the individual characteristics cannot be equated among them. With this reservation, it is possible only to compare the graduations capable of objective evaluation per individual type through juxaposition. For this reason, a peak group was combined in following synoptic table.

Of the 56 Salmonella types identified in Berlin during the period covered by the report, the 12 (listed below) could be characterized as "of greater risk". Disregarding the qualitative predominance of one characteristic over another, their indicated poles per group which show, e.g., in regard to distribution as causal factor Sal. breslau in first and Sal. give in last place. From the arrangement of the pole position, we can calculate from table 5 an order/or sequence of progression.

1. Sal breslau
2. Sal braenderup
3. Sal st. paul
4. Sal infantis
5. Sal newington
6. Sal enteritidis
7. Sal anatum
8. Sal blockley
9. Sal thompson
10. Sal give
11. Sal heidelberg
12. Sal bareilly

Although the conclusions were derived from a large amount of material over a relatively long period of time, they can be considered valid only for the period covered by the report. In future situations, such influences as capability of mutation and variation of the respective micro-organisms may be considered as additional exogenous factors.

A certain degree of reservation is necessary in interpreting the findings on the basis of biological mutability because the small-number character as well as the minor incidence of certain types (otherwise evaluated as a favorable characteristic) implies certain doubts. Especially here, the question of degree of risk could be clarified more easily -- at least in regard to pathogenicity -- if such a routinely applicable toxin demonstration existed also for endotoxin forming Sal. enter. as exists for the ectotoxin-forming diphtheria bacteria.

As an example of the only recently recognized biological lack of uniformity in the pathogenicity of a selfcontained bacterial species, the group of the coli bacilli may be mentioned. Up to now, it has been

regarded not as pathogen but as an indispensable symbiont. This viewpont changed when, among the coli bacilli, true germs (dyspepsia coli types) typical in their biological reactions, although serologically separable, were recognized as pathogens at the physiological location and of epidemiological significance.

A comparison with the situation for other enterobacteriaceae of the ballerup and arizona groups is even closer at hand. They are related to the true Salmonellae but separable serologically and metabolically. In the course of the years, this group, previously counted among the Salmonellae was separated and evaluated as not disease-producing in regard to evaluation for pathogenicity so that the application of epidemiological regulations was considered not necessary.

Interpreted with the necessary reservations, the results can be a help for the practical evaluation of infections with Sal. enter. for the physician in the clinical and the public health services as well as for the microbiologist.

For the clinician, knowledge of the distribution becomes important primarily in connection with the pathogenicity. He can expand his curative measures in view of a possible more servere illness. The tendency of a type for propagating more easily may give him the impulsion for special prophylactic measures in regard to milieu of family or hospital. Knowledge of the duration of emission of the individual types of Salmonella can also furnish practical indications to the clinician. Although three successive negative tests formally signify the termination of the prescribed measures, a more intensive control becomes justified where bacilli are concerned which have been demonstrated to possess a longer duration of emission. On the other hand, infections with Salmonella types with a known short duration of emission will facilitate an estimate of the usual period of hospitalization or other time-dependent factors.

With a more thorough knowledge of the special characteristics of the types of Salmonella, the physician in the public health services has a greater possibility, in addition to the usual morbidity factor in epidemiological statistics, to draw on other points of evaluation in order to lighten, within the limits of this discussion, control measures when the bacterial type is considered as "of lesser risk". In the opposite case, he is justified in increased control measures, especially in regard to unreasonable individuals where it is often indicated to prohibit treatment at home. In addition to the practical use in regard to the individual, health services can obtain from the evaluation of risk an overall epidemiological picture in which changes after

an increased incidence of certain germs can be estimated on a better basis. As regards epidemiology, there are further considerations of interrelation, e.g., to the veterinary sector, among others.

Beyond the limits of the diagnostic tasks for the clinic and the public health services, the microbiologist finds in at least three characteristics a field of endeavor which renders practical services to public health with its specific possibilities of research. For the latter, the pathogenicity shifts to the background and, by contrast, "distribution" is not only a definite determination and consequent specific aid for more narrowly restricted regional situations but also affords material for an interregional epidemiological evaluation which can be utilized for conclusions and comparisons in the national and international Salmonella centers. The effect of such regional determination of findings (as primary factor) can be particularly well recognized in the example of Berlin as a definitely restricted area of special character because changes become apparent more clearly and more quickly as against the epidemiology of larger areas.

That the findings obtained practically exceed, at least for the peak group compiled in table 5, the limits of an only theoretical statement, is supported by the reports on group infections through Sal. enter. in the literature available to us (Central Journal for Bacteriology, references 1950-1959). This concerns without doubt such manifestations which are striking enough to be reported so that they do not represent numerically an exhaustive review. After compilation, the reports produce a review on the factors of pathogenicity and distribution (incidence and group formation) within the sense of the characteristics of our discussion. Of the twelve types of the peak group described here, nine are already represented with comparable frequency in the literature. Of the total of 21 types noted, they represent not quite one-half but measured by the number of manifestations 60% of all reports.

Table 5

Order number	I Distribution	II Pathogenicity	III Group incidence	IV Duration of emission
1	breslau	breslau	breslau	give
2	anatum	gaertner	st. paul	newington
3	newington	braenderup	infantis	breslau
4	infantis	heidelberg	braenderup	st. paul
5	braenderup	infantis	anatum	thompson
6	st. paul	blockley	newington	blockley
7	thompson	st. paul	gaertner	braenderup
8	blockley	thompson	heidelberg	gaertner
9	gaertner	anatum	bareilly	infantis
10	give	newington	give	anatum

This observation stresses that the graduation of risk developed by us also recurs in the "enlarged raality". The other types noted in literature which are found also in part in our material but here do not belong to the peak group, do show only one single mention but thus prove that they also have an epidemiological significance. This justifies the reservation in the evaluation of those types of Salmonella which we could not definitely group for the reasons mentioned.

The question raised at the outset of whether there are types of Sal. enter of greater and of lesser risk can be affirmed on the basis of the investigative material for a past period of time. Risk can be "measured" on the basis of certain characteristics. The evaluation of "lesser risk" -- by definition -- as opposite pole does not furnish any reason to regard less noticeable types of Salmonella as so harmless that they could be eliminated from epidemiological regulations.

Summary: Based on experience gather from individual test cultures of 2,996 specimen of the species Salmonella isolated in West Berlin during the period from 1955 to 1959, a graduated scale of risk is proposed in accordance with incidence, pathogenicity, group formation and duration of emission. Investigation has shown such graduations to be present and the latter have been brought in relation both to the clinical and the epidemiological experience gained. Practical applicability of the results has been discussed but differentiation is not recommended in regard to present laws for the prevention of infectious diseases.